

CLAIMS:

1. In a data transmission system for transmitting data from a transmitter to a plurality of subscriber units, wherein:
 - the FCHs are combinable, in a hierarchical manner, into transmission channels of higher levels, each capable of carrying data at a corresponding rate level, which is a correspondingly higher rate than the fundamental rate;
 - any channel, if available, at any level, is periodically allocable to a corresponding one of the subscriber units, in order to carry data to the subscriber unit from a buffer storage during a subsequent period; and
- 10 there is a power level associated with each subscriber unit and with each rate level;
 - a method for periodically allocating channels to subscriber units, comprising, prior to the beginning of any period:
 - (a) identifying all active subscriber units being in communication with the transmitter and for which there are data, exceeding a given minimal quantity, stored in the buffer storage;
 - (b) calculating for each active subscriber unit one or more priority factors as a function of associated power levels;
 - (c) on the basis of said priority factors, allocating at least one channel, to a corresponding active subscriber unit;
 - (d) repeating the channel allocation in respect of any active subscriber units to which no channels have yet been allocated, subject to an availability of unallocated channels and subject to a limitation of maximum transmitter power.
 - 25 2. The method of claim 1, wherein said priority factors are calculated also as a function of the rate levels of channels allocable to the respective subscriber units.

3. The method of claim 2, wherein there is defined for the system a revenue function, the method further comprising:

(e) based on the revenue function, calculating, for each active subscriber unit and for each rate level of channels allocable to it, a revenue value;

5 said priority factors being calculated also as a function of corresponding revenue values.

4. The method of claim 3, wherein said revenue function operates on at least one of the following variables: amount of data in current message that has been transmitted, average rate of transmission of current message.

10 5. The method of claim 3, further comprising selecting a highest one of said priority factors.

6. The method of claim 5, wherein the subscriber unit associated with said highest priority factor is a candidate subscriber unit and allocating channels includes checking whether a channel at a higher rate level than that corresponding 15 to said highest priority factor is available and, if the priority factor that corresponds to the candidate subscriber unit and to said higher rate level satisfies a given criterion, allocating a channel at said higher rate level to the candidate subscriber unit.

7. The method of claim 5, wherein the subscriber unit associated with said 20 highest priority factor is a candidate subscriber unit and allocating channels includes:

(i) checking whether two combinable channels at a rate level identical to that corresponding to said highest priority factor are available and whether any one or more other subscriber units, distinct from the candidate subscriber unit, have 25 priority factors associated with said identical rate level, and

(ii) if a priority factor corresponding to one of said other subscriber units satisfies a given criterion, allocating said two channels to the candidate subscriber unit and to said one other subscriber unit, respectively.

8. The method of claim 1, wherein the data for any subscriber unit are grouped as messages and there is a promised transmission rate (PTR) associated with each subscriber unit, the method further comprising:

5 (f) accumulating for each active subscriber unit the amount of data of a current message transmitted to it and calculating therefrom an average transmission rate;

and wherein said priority factors are calculated also as a function of the PTR associated with the subscriber unit and of the average transmission rate for the subscriber unit.

10 9. The method of claim 1, wherein the ratio between the rates at any two rate levels is an integral power of 2.

10. The method of claim 1, wherein the data transmission system operates in CDMA mode and a channel is associated with a Walsh code.

11. The method of claim 1, wherein during each iteration, a single channel is 15 allocated to the subscriber unit having a highest one of said priority factors.

12. The method of claim 1, wherein during each iteration, a channel is allocated to the subscriber unit having a highest one of said priority factors and at least one more channel is allocated to a corresponding associated subscriber unit.

13. Dynamic channel allocation apparatus for use with a data transmission 20 system that transmits data from a transmitter to a plurality of subscriber units, the transmitter having a given maximum power level and a given number of fundamental transmission channels (FCHs), each FCH capable of carrying data at a given fundamental rate;

the FCHs are combinable, in a hierarchical manner, into transmission 25 channels of higher levels, each capable of carrying data at a corresponding rate level, which is a correspondingly higher rate than the fundamental rate;

any channel, if available, at any level, is periodically allocable to a corresponding one of the subscriber units, in order to carry data to the subscriber unit from a buffer storage during a subsequent period;

there is a power level associated with each subscriber unit and with each
5 rate level;

the apparatus comprising a digital processor that is programmed –
to calculate for each active subscriber unit one or more priority factors as a
function of associated power levels; and
for each of a succession of periods, to allocate a channel to each of one or
10 more active subscriber units, the allocation being based on one or more of
said priority factors.

14. The apparatus of claim 13, wherein said priority factors are calculated also
as a function of the rate levels of channels allocable to the respective subscriber
unit.

15 15. The apparatus of claim 14, wherein there is defined for the system a
revenue function and wherein said processor is further programmed to calculate,
for each active subscriber unit and for each rate level of channels possibly allocable
to it, a revenue value, based on the revenue function, and wherein said calculation
of priority factors is also as a function of corresponding revenue values.

20 16. The apparatus of claim 13, wherein:
the data for any subscriber unit are grouped as messages and there is a
promised transmission rate (PTR) associated with each subscriber unit;

25 said processor is further programmed to accumulate, for each active
subscriber unit, the amount of data of a current message transmitted to it, to
calculate therefrom an average transmission rate; and to calculate said priority
factors also as a function of the PTR associated with the subscriber unit and of the
average transmission rate for the subscriber unit.

17. The apparatus of claim 13, wherein the ratio between the rates at any two rate levels is an integral power of 2.
18. The apparatus of claim 13, wherein the data transmission system operates in CDMA mode and a channel is associated with a Walsh code.
- 5 19. The apparatus of claim 13, wherein any channel is allocated to the subscriber unit that corresponds to a highest one of said priority factors.
20. The apparatus of claim 13, wherein the transmission system is a cellular telephone system.
- 10 21. Dynamic channel allocation apparatus for use with a data transmission system that transmits data from a transmitter to a plurality of subscriber units, the transmitter having a given maximum power level and a given number of fundamental transmission channels (FCHs), each FCH capable of carrying data at a given fundamental rate; the FCHs being combinable, in a hierarchical manner, into transmission channels of higher levels, each capable of carrying data at a corresponding rate level, which is a correspondingly higher rate than the fundamental rate; any channel, if available, at any level, being periodically allocable to a corresponding one of the subscriber units, in order to carry to the subscriber unit, during a subsequent period, data provided therefor through the system; 15 20 a power level being associated with each subscriber unit and with each rate level; the apparatus comprising: a buffer storage, operative to store the data provided from the system in bins that correspond to subscriber units; 25 an allocator, which includes a digital processor that is programmed to: calculate for each active subscriber unit one or more priority factors as a function of associated power levels; and, for each of a succession of periods,

allocate a channel to each of one or more active subscriber units, the allocation being based on one or more of said priority factors; and

5 a flow controller, responsive to an output of said allocator and operative, with respect to each channel allocation, to retrieve from said buffer storage a corresponding amount of data and to send it to the transmitter, together with a corresponding channel designation.

22. The apparatus of claim 21, wherein said priority factors are calculated also as a function of the rate levels of channels allocable to the respective subscriber unit.

10 23. The apparatus of claim 21, wherein there is defined for the system a revenue function and wherein said digital processor is further programmed to calculate, for each active subscriber unit and for each rate level of channels possibly allocable to it, a revenue value, based on the revenue function, and wherein said calculation of priority factors is also as a function of corresponding
15 revenue values.

24. The apparatus of claim 21, wherein:

the data for any subscriber unit are grouped as messages and there is a promised transmission rate (PTR) associated with each subscriber unit;

20 said processor is further programmed to accumulate, for each active subscriber unit, the amount of data of a current message transmitted to it, to calculate therefrom an average transmission rate; and to calculate said priority factors also as a function of the PTR associated with the subscriber unit and of the average transmission rate for the subscriber unit.

25. The apparatus of claim 21, wherein the ratio between the rates at any two rate levels is an integral power of 2.

26. The apparatus of claim 21, wherein the data transmission system operates in CDMA mode and a channel is associated with a Walsh code.

27. The apparatus of claim 21, wherein the allocator is configured to allocate a channel to the subscriber unit that corresponds to the highest priority factor.

28. The apparatus of claim 21, wherein the transmission system is a cellular telephone system.

5 29. For use with a data transmission system for transmitting data from a transmitter to a plurality of subscriber units, wherein:

the FCHs are combinable, in a hierarchical manner, into transmission channels of higher levels, each capable of carrying data at a corresponding rate level, which is a correspondingly higher rate than the fundamental rate;

10 any channel, if available, at any level, is periodically allocable to a corresponding one of the subscriber units, in order to carry data to the subscriber unit from a buffer storage during a subsequent period; and

there is a power level associated with each subscriber unit and with each rate level;

15 a program storage device readable by machine, tangibly embodying a program of instructions executable by the machine to perform operations for periodically allocating channels to subscriber units, comprising, prior to the beginning of any period:

- i. identifying all active subscriber units being in communication with the transmitter and for which there are data, exceeding a given minimal quantity, stored in the buffer storage;
- 20 ii. calculating for each active subscriber unit one or more priority factors as a function of associated power levels;
- iii. on the basis of said priority factors, allocating at least one channel, to a corresponding active subscriber unit;
- 25 iv. repeating the channel allocation in respect of any active subscriber units to which no channels have yet been allocated, subject to an availability of unallocated channels and subject to a limitation of

maximum transmitter power.

30. In a data transmission system for transmitting data from a transmitter to a plurality of subscriber units, wherein:

the FCHs are combinable, in a hierarchical manner, into transmission channels of higher levels, each capable of carrying data at a corresponding rate level, which is a correspondingly higher rate than the fundamental rate;

any channel, if available, at any level, is periodically allocable to a corresponding one of the subscriber units, in order to carry data to the subscriber unit from a buffer storage during a subsequent period; and

10 there is a power level associated with each subscriber unit and with each rate level;

a computer program product comprising a computer useable medium having computer readable program code embodied therein for periodically allocating channels to subscriber units, the computer program product 15 comprising:

computer readable program code for causing the computer to identify prior to each period all active subscriber units being in communication with the transmitter and for which there are data, exceeding a given minimal quantity, stored in the buffer storage;

20 computer readable program code for causing the computer to calculate prior to each period for each active subscriber unit one or more priority factors as a function of associated power levels;

computer readable program code responsive to said priority factors for causing the computer to allocate prior to each period at least one channel, 25 to a corresponding active subscriber unit; and

computer readable program code for causing the computer to repeat the channel allocation in respect of any active subscriber units to which no channels have yet been allocated, subject to an availability of unallocated

channels and subject to a limitation of maximum transmitter power.